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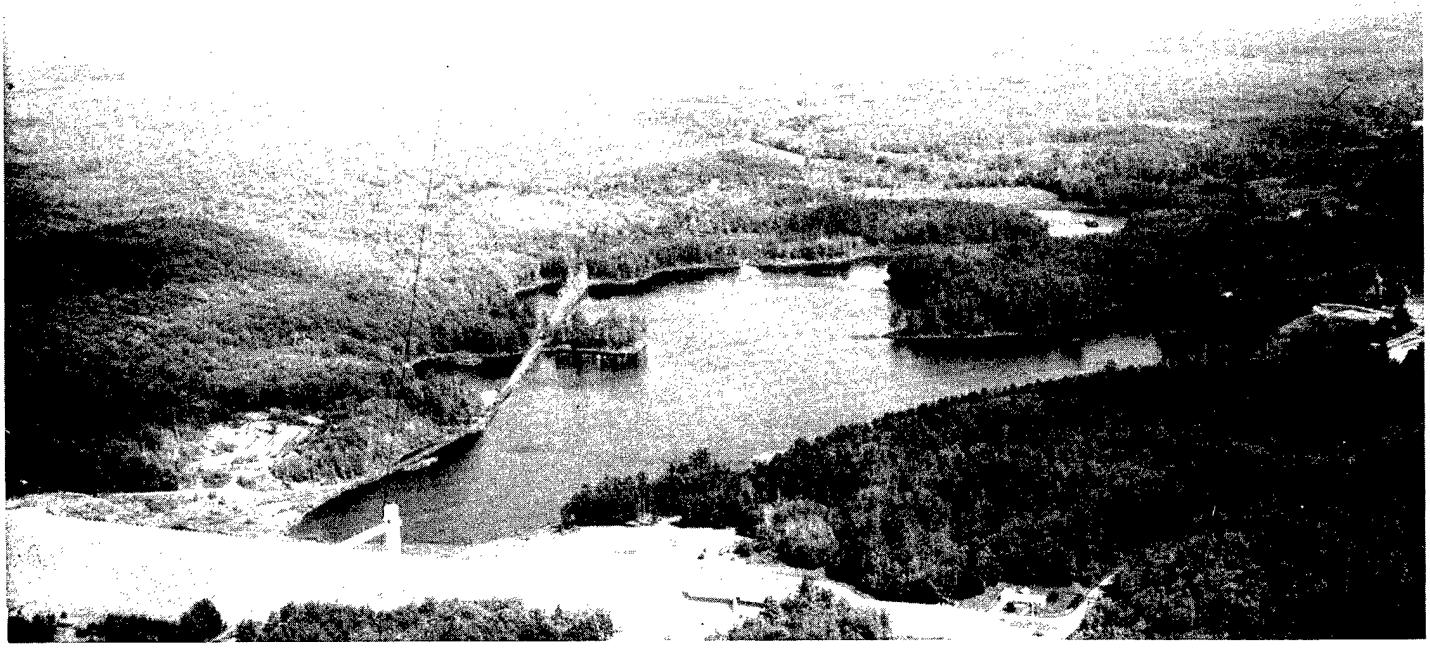
US Army Corps
of Engineers
New England District

Drought Contingency Plan

SEPTEMBER 1997

Everett Lake, Weare, New Hampshire



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Drought Contingency Plan

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Steve Simmer

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U. S. Army Corps of Engineers
New England District
424 Trapelo Road
Waltham, MA 02254-9149

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12a. DISTRIBUTION AVAILABILITY STATEMENT

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13. ABSTRACT *(Maximum 200 words)*

The purpose of this study and report was to develop and set forth a possible drought contingency plan of operation for Everett Lake that would be reponsive to public needs during drought periods and identify possible modifications to the project regulation within the current administration and legislative constraints. However, the state of New Hampshire has withdrawn support as sponsor for using Everett Lake as a source of emergency supply; therefore, this plan is not implementable.

14. SUBJECT TERMS
Drought Contingency Planning

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SUMMARY

In the 1990's NED started updating drought contingency plans that were previously developed in the 1980's for some of our reservoirs. One of the requirements to updating the drought contingency plans, to make them fully implementable, is state sponsorship. If there is no state sponsorship then a nonfeasible plan will be published for that particular project.

In letter, dated February 14, 1997 (copy attached), the State of New Hampshire Department of Environmental Services (DES) withdrew its support as a sponsor for the drought contingency plan at Everett Lake. The DES indicated for a variety of reasons, mainly the timing of the proposed drought storage, they currently are not interested in sponsoring emergency storage at the project. Therefore, the New Hampshire DES is not interested in entering into a contract with the Corps.

Since there is no state sponsorship for drought storage at Everett Lake, the drought contingency plan developed in 1984 is presented herein for informational purposes only. If, at some future date, the state were to indicate an interest, drought contingency storage will be re-evaluated and this report updated as necessary to respond to the state request.

DROUGHT CONTINGENCY STORAGE FOR EMERGENCY WATER SUPPLY PURPOSES AT EVERETT LAKE IS NOT IMPLEMENTABLE

NHDES

State of New Hampshire
DEPARTMENT OF ENVIRONMENTAL SERVICES
64 No. Main Street, P.O. Box 2008, Concord, NH 03302-2008
(603) 271-3406 FAX (603) 271-7894

February 14, 1997

Richard D. Reardon
Director of Engineering
Department of the Army
New England Div., Corps of Engineers
424 Trapelo Rd
Waltham MA 02254-9149

Dear Mr. Readon:

Your letter of February 4, 1997 requests information relative to the State of New Hampshire's participation in a Drought Contingency Plan and Memorandum of Agreement for the above referenced projects. By way of background, it is my understanding from previous studies and discussion with your staff that the contingency plan could only be implemented after declaration of a drought emergency by the State. At that time, the Corps would reduce discharge from the reservoirs to store the stipulated amount of water for later release as requested.

This approach presents a problem to us because once a drought emergency is declared we are already experiencing extremely depleted streamflows. Further reduction in streamflows to store water would increase the adverse effects already being experienced. Based upon this understanding, the state is not interested in participating in an agreement at this time.

We have advocated in the past for a permanent reallocation of a small portion of the flood control storage for streamflow maintenance and drought mitigation. Should you be able to raise the normal pool the two to three feet proposed in the drought plan on a permanent basis, this water would be available to mitigate drought impact. This is a far more fundamental issue which must be addressed relative to the mission of the projects. More active management of some of the available storage for other purposes on a seasonal basis is an item for future discussion.

Thank you for inquiring as to our interest. Should you have any questions, please contact me at your convenience.

Sincerely,

Kenneth J. Stern, PE
Chief Water Resources Engineer

cc: Robert W. Varney, Commissioner
Edward J. Schmidt, Director
KJS\ss\h:\kjs\reardon.ltr

DEPARTMENT OF THE ARMY
NEW ENGLAND DIVISION, CORPS OF ENGINEERS
424 TRAPELO ROAD
WALTHAM, MASSACHUSETTS 02254-9149

REPLY TO
ATTENTION OF

February 4, 1997

Engineering - Water Control

Mr. Kenneth Stern, Chief Engineer
New Hampshire Department of Environmental Services
Water Division
P.O. Box 2008
Concord, New Hampshire 03302-2008

Dear Mr. Stern:

The New England Division, Corps of Engineers, is currently updating previously developed plans for drought contingency storage at some of our reservoirs in New Hampshire. We have identified these projects as having merit in providing a source of water supply during drought emergency conditions. We are writing to you with respect to the State of New Hampshire's interest in emergency storage at these projects. Listed below are names and locations of each candidate reservoir in your State. Attachments 1 through 4 present fact sheets with pertinent information for each project, and attachments 5 and 6 show locations.

Name	Location
Edward MacDowell Dam*	Peterborough
Surry Mountain Lake	Surry
Everett Lake	Weare

* 1992 investigations indicated no interest from the town of Peterborough or other communities in the area

These are the remaining three Drought Contingency Plans (DCP) to be updated for your State. As you know, an updated plan for Otter Brook Lake was completed in 1992 and has been excluded from the above list. This implementable plan lists your agency as the lead agency to act as sponsor for the plan.

The DCP presents a basic planning aid assessment of Corps projects as a potential emergency short-term water supply source during a State-declared drought emergency, with each DCP identifying the following:

a. Hydrologic assessment of drought storage potential.

b. Standard operating procedure for drought storage and releases.

c. State participation in the plan.

d. Draft Memorandum of Agreement (contract) identifying how water will be received and distributed as well as cost.

In an effort to update the DCPs for these projects, we are requesting your agency forward a letter to this office expressing your interest (or lack of interest) in participating in the program for each of the remaining candidate reservoirs in your State. You are; therefore, encouraged to review the attached information on the proposed plans and determine your interest in the plans. If there is interest, your letter should identify the appropriate State-sponsored agency acting as signatory to the contract, potential water supply user, and method of transporting water (i.e., reservoir releases, trucking, etc.) for each project.

It should be noted that your 1992 investigations indicated no interest on the part of Peterborough, or other communities in the area, in the use of emergency storage from Edward MacDowell Dam for potable water supply. The attached information sheets on the proposed Edward MacDowell Dam emergency storage plan (attachment 1) and historic low flow data (attachment 2) are provided so you can decide whether there is State interest in the use of emergency storage.

In conclusion, your letter should be a response with respect to the State of New Hampshire's interest in Edward MacDowell Dam, Surry Mountain and Everett Lakes for emergency storage. If you have any questions regarding this request, please contact Mr. Steven Simmer at 617-647-8524.

Sincerely,

Richard D. Reardon
Director of Engineering

Attachments

CF:
Mr. Simmer - 115N ✓
Reading Files
Engr Dir Files - 112S

MERRIMACK RIVER BASIN
PISCATAQUOG RIVER WATERSHED

DROUGHT CONTINGENCY PLAN
EVERETT LAKE
WEARE, NEW HAMPSHIRE

JULY 1984

NEW ENGLAND DIVISION, CORPS OF ENGINEERS
424 TRAPELO ROAD
WALTHAM, MASSACHUSETTS 02254-9149

SYLLABUS

A drought contingency plan was studied for Everett Lake in an effort to be responsive to public needs during drought situations. It was determined that water could be temporarily stored to an elevation of 343 feet NGVD, 3 feet above the permanent pool, providing up to approximately 1,325 acre-feet (432 million gallons) of reservoir storage for drought emergency purposes.

An evaluation of the effects of this plan has revealed some adverse impacts on the aquatic and terrestrial environments. The water at Everett Lake is of basically good quality but has high levels of color and metals which will have to be removed before it is adequate for public water supply.

DROUGHT CONTINGENCY PLAN
EVERETT LAKE

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DROUGHT CONTINGENCY PLAN
EVERETT LAKE

1. PURPOSE AND SCOPE

The purpose of this study and report was to develop and set forth a drought contingency plan of operation for Everett Lake that would be responsive to public needs during drought periods and to identify possible constraints. This evaluation was based on preliminary studies using readily available information. This drought contingency plan includes a description of existing water supply systems, the possibility of reallocation of reservoir storage within specified limits, evaluation of water quality, discussion of impacts on other project purposes, effects on the environment, and summary and conclusions.

2. AUTHORIZATION

The authority for the preparation of drought contingency plans is contained in ER 1110-2-1941 which provides that water control managers will continually review, and, when appropriate, adjust water control plans in response to changing public needs. Drought contingency plans will be developed on a regional, basinwide and project basis as an integral part of water control management activities.

3. PROJECT AUTHORIZATION CONDITIONS

Everett Lake is a unit of the dual Hopkinton-Everett Lake Project. The combined project was authorized by the Flood Control Act of 28 June 1938, House Document No. 689, 75th Congress, 3rd Session, as amended by the Acts of 1941 and 1944 and the Merrimack River Flood Compact of 1957.

4. PROJECT DESCRIPTION

Everett Lake is located on the Piscataquog River in the town of East Weare, New Hampshire. A map of the Merrimack River basin is shown on plate 1.

The project contains storage for flood control and recreation. The recreation pool at elevation 340 feet NGVD contains 1,000 acre-feet. This recreation or permanent pool is maintained at a depth of about 15 feet creating a 115-acre pool. The flood control storage amounts to 91,500 acre-feet (29.8 billion gallons) when filled to spillway crest. A capacity table is shown on plate 2 and a summary of pertinent data at Everett Lake is contained on plate 3.

Components of the project consist of a rolled earthfilled dam with rock slope protection, a concrete spillway, outlet works and two earth dikes, and a canal. The outlet works consist of an intake structure, gate tower and an 8-foot circular conduit. The intake end of the conduit contains three 3'-6" wide by 6'-0" high sluice gates, with invert at elevation 325. A permanent concrete weir containing stoplog openings is located upstream of the center gate and maintains a permanent pool at about elevation 340.

Dike P-1 is located on Stack Brook and consists of a rolled earthfill embankment with a length of 4,050 feet. Dike P-2, constructed the same as dike P-1, is located across a saddle separating the Piscataquog and Merrimack River valleys.

Canal No. 2 is about 10,400 feet in length and connects Hopkinton and Everett Lakes.

5. PRESENT OPERATING REGULATIONS

a. Normal Periods. A permanent pool is maintained at a stage of about 15 feet by the control weir and stoplogs located immediately upstream of the center gate. The gate setting, 0-2'-0.1', restricts discharges so that significant reservoir releases do not occur during unexpected events. During the winter, the center gate and one of the outside gates are closed. The other outside gate is partially opened to maintain the pool at the 15-foot stage.

b. Flood Periods The Everett project is operated in concert with other projects in the basin to reduce downstream flooding along the Piscataquog River and further downstream in the Merrimack River. Operations for floods may be considered in three phases: phase I - appraisal of storm and river conditions during development of a flood; phase II - flow regulation and storage of flood runoff at the reservoir, and phase III - emptying the reservoir during recession of the flood. The regulation procedures are detailed in the Master Water Control Manual for the Merrimack River Basin.

c. Regulating Constraints

(1) Minimum Releases. A minimum release of about 10 cfs (6.5 mgd) is maintained during periods of flood regulation in order to sustain downstream fish life.

(2) Maximum Releases The maximum nondamaging discharge capacity of the channel immediately downstream of Everett Lake is about 1,500 cfs.

Releases at or near this rate can be expected whenever reservoir inflows exceed this value, and meteorologic and hydrologic conditions permit.

6. MONITORING OF HYDROLOGIC CONDITIONS

The Reservoir Control Center directs the reservoir regulation activities at 28 New England Division flood control dams, and continually monitors rainfall, snowcover and runoff conditions throughout the region. When any of these hydrologic parameters have been well below normal for several months and it appears that possible drought conditions might develop, the Corps Emergency Operations Center (EOC) will be so informed. The EOC will then initiate discussions with the respective Federal and State agencies and other in-house Corps elements to review possible drought concerns and future Corps actions.

7. DESCRIPTION OF EXISTING WATER SUPPLY CONDITIONS

a. General. The area of concern is the central portion of New Hampshire including portions of Hillsborough and Merrimack counties. Table 1 contains information about public water suppliers in the area based on information provided by the New Hampshire Water Supply and Pollution Control Commission. Of the 17 communities in the study area, 12 are served by public systems. No data is available for those communities dependent on private individual supplies.

b. Water Supply Systems. The primary objective of this analysis was to accumulate available data regarding water supply systems in the vicinity of Everett Lake that could benefit from storage at the project, and to present the data in a manner portraying existing water supply conditions. Projections of future demands were not developed because this study addresses only modifications in the operational procedure at Everett Lake in order to provide storage for water supply purposes when drought conditions exist, and not to meet normal water supply demands at some future date.

c. Central New Hampshire Water Suppliers. As noted in table 1, the data given for each water supplier includes: community served, estimated population served by the system, source of supply (ground or surface water), average day and maximum day demands for 1981, estimated safe yield of the source, and any further information available on the source of supply. An analysis of the adequacy of existing sources during drought conditions has not been performed. The information has been accumulated to present a summary of the existing water supply conditions for the central New Hampshire area.

TABLE 1
MAJOR WATER SUPPLIERS - CENTRAL NEW HAMPSHIRE

Company or Agency	Town Served	Est. Population Served 1981	Source of Supply SW/GW	1981 Demand Avg. Day (MGD)	1981 Demand Max. Day (MGD)	Supply Source	Safe Yield (MGD)
	Bedford	(656 Connections)				Manchester Water Works	
Boscawen/ Penacook Water Precinct	Boscawen	800	SW	0.485	0.800	Walker Pond	2.20
	Bow	(1 Connection)				Concord Water Works	
	Bradford		No Public Water Supply				
Concord Water Works	Concord	(7.198 Connections)	SW/GW	4.043	6.150	Long Pond	2.60
						Contooocook R.(Ave)	10.00
						GP #1 Tr. Pland	1.00
						GP #3	1.00
						GP #5	1.00
						GP #7	1.00
	Deering	(9 Connections)				Hillsborough Water Works	
	Dunbarton		No Public Water Supply				
Goffstown Village Water Precinct	Goffstown	3100	GW	0.175	0.350	Dug	0.13
						BR #1	0.16
						Dugwell	0.05
						BR #2	0.02
		(931 Connections)				(Manchester Water Works)	
Cogswell Spring Water Works	Henniker		GW	0.350	0.450	GP #1	-
						GP #2	-
						GP #3	-
Hillsboro Water Works	Hillsboro	2000	SW	0.300	0.450	Loon Lake	1.20

Company or Agency	Town Served	Est. Population Served 1981	Source of Supply SW/GW	1981 Demand Avg. Day (MGD)	1981 Demand Max. Day (MGD)	Supply Source	Safe Yield (MGD)
Hillsboro Water Co. Inc. (Emerald Lake Shores)		(275 Connections)	GW			BR #1 BR #4 BR #5 BR #6	0.04 0.04 0.03 0.02
Hooksett Village Water Precinct	Hooksett	2400	SW	0.150	-	Pinnacle Pond	--
Central Hooksett Water Precinct		1500	GW	0.275	0.475	GP #1 GP #2 GP #3	0.20 0.21 0.20
		(299 Connections)				Manchester Water Works	
Contoocook Fire District	Hopkinton	1500	SW	0.225	0.320	Bear Pond	0.48
Manchester Water Works	Manchester	105,000	SW	13.000	26.000	Lake Massabesic	22.00
	New Boston		No Public Water Supply				
Warner Village Fire District	Warner	525	SW/GW	0.045	0.063	Silver Lake BRW #1 (Aux)	-- --
Weare			No Public Water Supply				
Webster			No Public Water Supply				

d. Population Projections. Population projections for communities in central New Hampshire are given in table 2 to show population trends for each community potentially affected by a prolonged dry period. The projections were provided by the New Hampshire Office of State Planning based on criteria derived by the Corps of Engineers for the Southeastern New Hampshire Water Resources Study.

8. POTENTIAL FOR WATER SUPPLY REALLOCATION

a. General. There are several authorities that provide for the use of reservoir storage for water supply at Corps of Engineers projects. They vary from the provision of water supply storage as a major purpose in new projects to the discretionary authority to provide emergency supplies to local communities in need. In addition, guidance contained in ER 1110-2-1941 direct field offices to determine the short-term water supply capability of existing Corps reservoirs. Congressional authorization is not required to add municipal and industrial water supply if the related revisions in regulation would not significantly affect operation of the project for the originally authorized purposes.

b. Drought Contingency Storage. It has been determined that a portion of the existing storage at Everett Lake could be utilized for emergency drought storage without having an adverse impact on the project's flood control function. Storage could be made available to a pool elevation of about 343 feet NGVD (18-foot stage). This represents a volume of about 1,325 acre-feet, equivalent to 432 million gallons or about 1½ percent of the total Everett reservoir storage. This volume is comprised of 1,000 acre-feet of permanent storage (elevation 340), and 325 acre-feet of flood control storage (elevation 343). The 325 acre-feet represents an infringement of about 0.10 inch of runoff on the flood control storage from the total drainage area of 64 square miles.

Based on an all-season low flow duration analysis using 19 years of flow records for the gaging station on the Piscataquog River near East Weare, New Hampshire, it was determined that during a 10-year frequency drought period the volume of runoff could: (a) fill the reservoir from elevation 340 to 343 feet in a 45-day summer period provided no releases were made from the dam, or (b) fill the reservoir to elevation 343 in a 134-day period of a continuous release of about 6.4 cfs or 4 mgd (0.10 cfs/sq. mi., csm) were maintained. Drought contingency storage versus flow duration at Everett Lake is graphically shown on plate 4.

The Everett Reservoir could be filled to elevation 343 in about a two-week period in May while continuously releasing about 10 cfs or 6.5 mgd. The stored water could be drawn directly from the reservoir or released downstream for municipal supply with proper treatment.

TABLE 2
POPULATION PROJECTIONS - CENTRAL NEW HAMPSHIRE

TOWN	Actual 1980	1985	1990	1995	2000	Percent-Change 1980-2000
Bedford	9,500	10,944	11,803	12,728	13,289	39.8
Boscawen	3,419	3,470	3,496	3,527	3,586	4.9
Bow	4,014	4,653	5,246	5,915	6,422	60.0
Bradford	1,109	1,285	1,448	1,632	1,772	59.8
Concord	30,360	31,502	32,107	32,774	33,639	10.8
Deering	1,046	1,204	1,299	1,400	1,462	39.8
Dunbarton	1,173	1,360	1,529	1,719	1,863	58.8
Goffstown	11,319	12,694	13,366	14,103	14,720	30.0
Henniker	3,236	3,612	3,915	4,251	4,558	40.9
Hillsborough	3,431	3,747	3,924	4,110	4,222	23.0
Hooksett	7,293	7,978	8,484	9,027	9,364	28.4
Hopkinton	3,841	4,314	4,713	5,149	5,471	42.4
Manchester	90,757	92,671	93,293	93,955	94,612	4.2
New Boston	1,947	2,235	2,411	2,600	2,715	39.4
Warner	1,956	2,268	2,500	2m757	2,948	50.7
Weave	3,218	3,706	3,996	4,310	4,499	39.8
Webster	1,092	1,265	1,424	1,604	1,742	59.5
TOTAL	178,715	188,908	194,954	201,561	206,884	15.8

c. Effects of Regulated Flows. The curtailment of flows from Everett Lake during the drought emergency could adversely impact on the flowage rights of downstream riparian users. At this time, however, it is not possible to review all of the various drought emergency situations that could occur, nor is it within the scope of this report to identify all those with water rights. It is important to note that when a specific drought emergency does occur, the legal implications would have to be weighed.

9. WATER QUALITY EVALUATION

a. Water Quality Classification. The Piscataquog River in the Everett project area, is rated class B by the New Hampshire Water Supply and Pollution Control Commission. Class B waters have high aesthetic value and are acceptable for swimming and other recreation, fish habitat, and, after adequate treatment, for use as water supplies.

Technical requirements for class B waters include no objectionable physical characteristics, a minimum dissolved oxygen concentration of 75 percent saturation or 6 mg/l, pH in the range of 6.5 to 8.0 standard units or as naturally occurs, no more than 240 coliform bacteria per 100 milliliters, and a maximum turbidity level of 10 JTU's.

b. Existing Water Quality. There are no significant upstream point sources of pollution and the waters of Everett Lake are of good quality, generally meeting the requirements of their New Hampshire class B designation. However, acid precipitation on poorly buffered soils and natural watershed conditions including swamps and marshes affect some water quality degradation - fluctuating DO levels, low pH levels, and high bacteria counts.

Although dissolved oxygen readings on the Piscataquog River are usually high, occasional low readings occur in the deepest parts of the lake during summer stratification. The occurrence of anaerobic conditions is minimized by opening one of the low level slide gates a small amount. This low level release does not violate state standards because it is mixed with the well aerated surface water flowing over the weir at the center gate.

Low pH levels at Everett Lake, which frequently are below the desirable minimum for class B waters, are not a health problem in a public water supply but may cause corrosion problems.

High total coliform bacteria counts have occurred throughout the project's history and are attributed to natural origins such as wildlife.

Water quality conditions for which there are no state standards but that are of possible concern in a public water supply include high iron, mercury, and color concentrations. High iron levels at Everett Lake are rare. Iron is not a health hazard in water, but high levels of iron can cause taste and laundry-staining problems. Findings of detectable concentrations of mercury at this project are very rare, but a few slightly elevated readings have been recorded. Though the source has not been determined, a real cause for concern is not indicated. Color concentrations are moderate to high. While not a health hazard, highly colored water is unappealing to water consumers. High color, iron, and mercury levels can be reduced by standard processes.

Everett Lake is a mesotrophic impoundment exhibiting weak to strong thermally-induced density stratification during the summer. The lake has a hydraulic residence time (the lake volume divided by the outflow) of 1 to 4 weeks under normal summer flow conditions. Under minimum flow conditions the lake approaches complete stagnation. Summer temperatures are usually less than 85°F, and the lake can support a good warm water fishery.

c. Water Quality Requirements for Drought Storage. There are two requirements to be met. The waters must meet state standards for surface waters and must be of a quality appropriate for the water supply user. A water which meets class B criteria in New Hampshire is usable for public water supply with standard treatment processes. The water quality required for industrial water supply depends on the industrial process involved. The water at Everett Lake would always be of a quality suitable for fire-fighting or irrigation.

d. Effects of Drought Storage. Increasing the pool volume at Everett Lake for drought storage will affect existing water quality in the lake. With the proposed depth increase of 3 feet, an additional 36 acres of land would be flooded. Present hydraulic residence time would increase from 1 to 4 weeks to 2 to 6 weeks during normal summer flow conditions and under minimum flow conditions the lake would become stagnant. This would lead to increased levels of color concentration and possibly more frequent occurrences of high metal levels. Increasing streamflow at this project generally results in the desirable effects of improved DO and decreasing total coliform bacteria counts and color concentrations. Minimum flow conditions during drought storage would be expected to produce lower DO levels and increasing bacteria counts and color concentrations. These conditions would not affect the water's suitability for public water supply. The trophic status is not likely to change and the water quality for recreation and fishing will not be affected.

Raising the pool 3 feet would also cause slight increases in turbidity and sedimentation. The death of the vegetation in the newly inundated areas would loosen the soil and cause increased erosion in these areas when the pool is drawn down. Most of the eroded soil would settle in the lake, but some would be discharged downstream. This increased erosion and sedimentation will not affect the suitability of the water for water supply or recreation, but will diminish the aesthetics of the area.

e. Water Quality Conclusions. The water at Everett Lake is of basically good quality but has high levels of color and metals which will have to be removed before it is adequate for public water supply. Undesirable color and metals can be removed by standard treatment processes. No treatment would be required for the water to be acceptable for fire-fighting, irrigation, or some industrial processes. Raising the pool elevation by 3 feet to provide extra storage would cause small increases in the levels of some undesirable parameters but would not significantly affect the suitability of the water for water supply or recreation.

10. DISCUSSION OF IMPACTS

a. General. Any action resulting in a temporary change of a reservoir's storage volume might have impacts on other project purposes which must be evaluated before a storage reallocation plan can be implemented. An evaluation has been made of the impacts resulting from drought contingency storage on the flood control purpose of this project. Effects on recreation, sedimentation and the aquatic and terrestrial environments as well as the historic and archaeological resources are discussed in the following paragraphs. Because of the minimal level of effort afforded this study, certain environmental concerns may require further consideration prior to project implementation. These are identified in the appropriate environmental sections including some with estimates of the amount of time needed for such assessments.

b. Flood Control. A review of the regulation procedures at Everett Lake was undertaken to determine the volume of water that could be made available for drought contingency purposes. The water would be stored by temporarily utilizing existing flood control storage. It is recognized that major floods occur in every season of the year, thus any use of flood control storage would be continually monitored to insure there would be no adverse impacts on downstream flood protection.

At Everett the maximum pool elevation for drought contingency storage has been estimated to be elevation 343 feet, representing an infringement on the flood control storage of about 0.10 inch of runoff from the total Everett Reservoir drainage area of 64 square miles.

Based on a 10-year event, the anticipated rate of pool level rise would exceed 0.02 foot per day over a 134-day period beginning in June. This condition assumes a flow of about 6.4 cfs (4 mgd) would be released downstream for the duration of the drought. Storage would probably take place during the months of June, July and August and would be drawn as needed in the subsequent months. It is likely that the storage would be held for a period of one month or longer at the 343-foot elevation before withdrawal.

c. Recreation. Limiting the drought contingency storage pool to elevation 343 will protect the recreational values of the Clough State Park currently leased to the New Hampshire Department of Resources and Economic Development. No recreational resource would be affected by this storage level.

d. Project Operations. In order to maintain the Everett drought storage pool at elevation 343 it will be necessary to regulate gates since the control weir is limited to a top elevation of 342. All costs associated with adjusting gates for drought storage, removal of abnormal amounts of floating trash at the log boom, and removal of any vegetation that dies as a result of long term flooding will be the responsibility of the requestor.

e. Effects on the Aquatic Ecosystem. Brook, rainbow and brown trout are stocked annually in several streams while good native populations of large and small mouth bass, pickerel, horned pout, yellow and white perch and sunfish are found in many areas along with several species of nongame fish.

Extreme seasonal fluctuations on water level affect cover shelter and reproduction habitat. While yearly water level fluctuations do not eliminate entire populations, they may decrease numbers considerably. If the contingency plan is approved then additional studies amounting to 6 to 8 days of field sampling may be required to determine the effects on fish populations and spawning success.

An increase in the impoundment for the proposed contingency storage would temporarily raise the lake's water level by approximately three feet during late summer - early fall and throughout the storage period. This would temporarily inundate areas of shallow stream habitat, wetland areas and shoreline. The increase in storage could impact habitat or reproductive conditions of most warm water species depending on when the drought storage is initiated.

The water level fluctuations in the permanent pool acts to scour the littoral area. This would limit the shoreline vegetation, fish populations, and impacts that might otherwise be associated with a rise in pool level for a couple of months for drought contingencies.

An increase in the pool level of the amount proposed would eliminate an estimated 12-15 acres of marsh lands. The actual impacts and the potential for new wetlands to be created, would also have to be assessed. Should the contingency storage be required for prolonged periods, continuous use of the wetlands for ducks and geese as well as nesting and feeding habitat for other bird species such as the red wing blackbird, could be jeopardized.

f. Effects on the Terrestrial Environment. There are three forest types at Everett Lake. The predominant one being a white pine. The second most frequent forest cover is a white pine, northern red oak and red maple mix and the third is red oak - red maple and white pine composition. Raising the impoundment elevation 3 feet for short seasonal periods would flood approximately 12-15 acres of terrestrial and wetland habitat. There would also be a loss of the access road which circumvents the lake. The potential effects on a new shoreline would include sloughing, erosion and root exposure due to prolonged operation. Storage for any length of time would kill tree species such as oak, hemlock, white pine, beech and maples and any grass coverage. Plate 5 shows a map of the reservoir area.

g. Effects on Wildlife. The Hopkinton-Everett Reservoir is generally considered good game habitat. The species present include, in order of importance: white-tailed deer, ruffed grouse, snowshoe hare, woodcock, waterfowl, and grey squirrel. In addition, there are numerous furbearers which inhabit the basin including beaver, muskrat, mink, otter, fisher, raccoon, skunk, fox, bobcat, and weasels.

Hunting pressure on this public area is considered moderate and the wildlife resources are considered in balance at the present time.

New Hampshire game laws are enforced by Conservation Officers. Pheasant stocking and hunting exist on a put-and-take basis. A deer population is present but no survey as to the size has been undertaken. Moose and bear have been reported in the area, but probably occur only as occasional migrants.

Waterfowl do breed in the area and the species most often found are Wood Duck (Aix sponsa),Hooded Merganser (Lophodytes cucullatus), and Black Duck (Anas rubripes). There is moderate hunting pressure on all

species. Although a waterfowl census has not been conducted, managers believe the populations probably include representatives of all native species at one time of the year or another.

New Hampshire Fish and Game Department has issued trapping permits. Results of the trapping indicate that population levels of beaver, mink, otter, fisher, muskrat, raccoon, and red fox remain fairly constant.

The proposed increase in the impoundment would destroy a variety of habitat. The anticipated loss of vegetation would degrade wildlife habitat. Wildlife would be displaced onto adjacent land where the habitat would not be able to support the additional population. Mammals such as muskrat which depend on the aquatic habitat may suffer significant mortality due to the flooding of den sites.

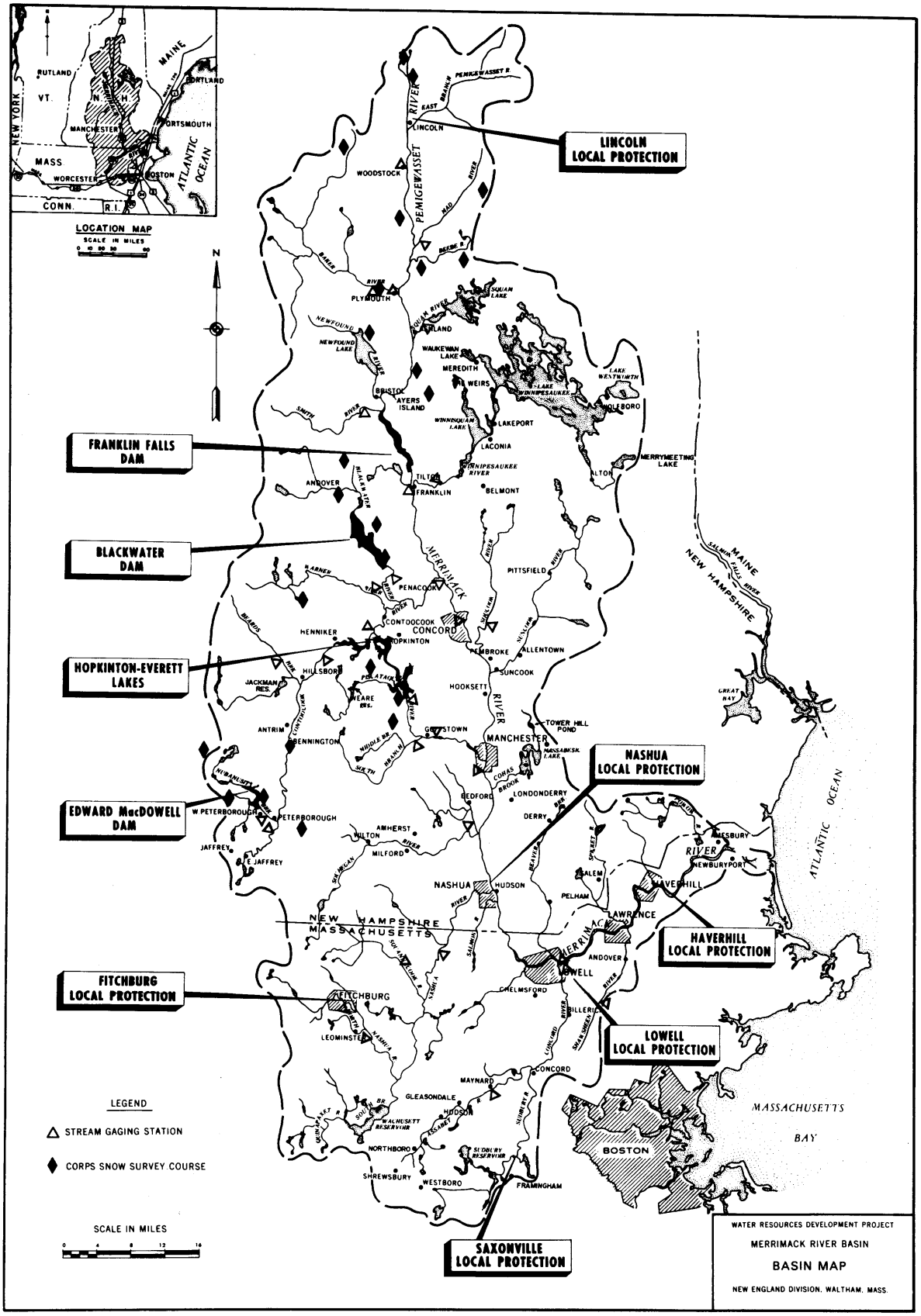
h. Historic and Archaeological Resources. Examination of mid-19th century maps reveal one recorded historic period site below 343 NGVD, and no prehistoric resources are recorded within the project. However, as the project has never been subjected to an archaeological survey, unrecorded prehistoric or historic resources may exist within the area affected by this drought contingency plan.

Prior to drought contingency implementation, an archaeological survey would be required, involving several weeks duration.

11. SUMMARY AND CONCLUSIONS

It has been determined that a portion of the existing storage at Everett Lake could be utilized for emergency drought purposes without having an adverse impact on the project's flood control functions. The water could be temporarily stored to an elevation of 343 feet. At this level, 3 feet above the permanent pool, it would be possible for the project to provide up to approximately 1,325 acre-feet (432 million gallons) of reservoir storage for drought emergency purposes. An evaluation of the effects of this plan has revealed some adverse impacts on the aquatic and terrestrial environments.

The water at Everett Lake is of basically good quality but has high levels of color and metals which will have to be removed before it is adequate for public water supply. Undesirable color and metals can be removed by standard treatment processes. No treatment would be required for the water to be acceptable for fire-fighting, irrigation, or some industrial processes.


LINCOLN LOCAL PROTECTION
FRANKLIN FALLS DAM
BLACKWATER DAM
HOPKINTON-EVERETT LAKES
EDWARD MacDOWELL DAM
FITCHBURG LOCAL PROTECTION
SAXONVILLE LOCAL PROTECTION
NASHUA LOCAL PROTECTION
HAVERHILL LOCAL PROTECTION
LOWELL LOCAL PROTECTION
LOCATION MAP
SCALE IN MILES
LEGEND
STREAM GAGING STATION
CORPS SNOW SURVEY COURSE
SCALE IN MILES
WATER RESOURCES DEVELOPMENT PROJECT
MERRIMACK RIVER BASIN
BASIN MAP
NEW ENGLAND DIVISION, WALTHAM, MASS.
PLATE 1

AREA-CAPACITY TABLE

HOPKINTON AND EVERETT LAKES

Hopkinton Lake
DA = 382 square miles (net)
1 inch Runoff = 20,358 acre-feet (net)

Pool Elevation (ft, msl)	Area (acres)	Capacity (ac/ft)
380*	220	700
381		1,000
382		1,360
383		1,790
384		2,225
385	610	2,760
386		3,390
387		4,200
388		5,030
389		6,050
390	1,130	7,150
391		8,490
392		9,700
393		11,050
394		12,450
395	1,590	14,000
396		15,790
397		17,550
398		19,360
399		21,385
400	2,110	23,500
401		25,300
402		27,750
403		30,100
404		32,600
405	2,650	35,200
406		38,000
407		40,900
408		43,800
409		46,800
410	3,200	49,840
411		53,125
412		56,400
413		59,800
414		63,400
415	3,600	66,580
416**		70,800
417		74,300
418		78,250
419		82,295
420***	4,090	86,300

Everett Lake
DA = 66 square miles
1 inch Runoff = 3,410 acre-feet

Pool Elevation (ft, msl)	Area (acres)	Capacity (ac/ft)	Pool Elevation (ft, msl)	Area (acres)	Capacity (ac/ft)
340*	115	1,000	380	1,016	18,500
341		1,100	381		19,500
342		1,200	382		20,500
343		1,325	383		21,750
344		1,450	384		23,000
345	175	1,675	385	1,288	24,250
346		1,900	386		25,500
347		2,100	387		26,750
348		2,300	388		28,000
349		2,500	389		29,585
350	243	2,700	390	1,485	31,170
351		2,950	391		32,585
352		3,200	392		34,000
353		3,450	393		35,900
354		3,700	394		37,800
355	297	4,000	395	1,702	39,400
356		4,300	396		41,000
357		4,650	397		42,750
358		5,000	398		44,500
359		5,345	399		46,500
360	361	5,690	400	1,942	48,500
361		6,095	401		50,250
362		6,500	402		52,000
363		6,900	403		54,250
364		7,300	404		56,500
365	444	7,750	405	2,207	58,750
366		8,200	406		61,000
367		8,650	407		63,250
368		9,100	408		65,500
369		9,700	409		67,940
370	617	10,300	410	2,497	70,380
371		11,000	411		72,990
372		11,700	412		75,600
373		12,350	413		78,300
374		13,000	414		81,000
375	809	13,875	415	2,829	83,750
376		14,750	416		86,500
377		15,625	417		89,500
378		16,500	418**		92,500
379		17,500	419		95,500
			420***	3,140	98,500

* Permanent Pool
** Spillway Crest
*** Flowage Easement Limit

PLATE 2

PERTINENT DATA

HOPKINTON-EVERETT LAKES

	Hopkinton	Everett	Total
LOCATION	Contoocook River, Hopkinton, N. H.	Piscataquog River, Weare, N. H.	
DRAINAGE AREA	382 square miles*	64 square miles	446 square miles*
STORAGE USES	Flood control and recreation		
RESERVOIR STORAGE			
At Inlet Elevation (ft, msl)	366	325	-
Area (acres)	0	0	0
Acre-Feet	0	0	0
At Permanent Pool (ft, msl)	380	340	-
Area (acres)	220	130	350
Acre-Feet	700	1,000	1,700
Inches on Drainage Area	Less than 0.1	0.3	Less than 0.1
At Spillway Crest (ft, msl)	416	418	-
Area (acres)	3,700	2,900	6,600
Acre-Feet	70,100**	91,500**	161,600**
Inches on Drainage Area	3.4	26.8	6.8
EMBANKMENT FEATURES			
Type	Rolled earth fill with rock slope protection		
Length (feet)	790	2,000	
Top Elevation (ft, msl)	437	435	
Maximum Height (feet)	76	115	
Top Width (feet)	24	24	
Slopes	1 on 2.5	1 on 2 to 1 on 2.5	
SPILLWAYS			
Type	Concrete ogee weir	Concrete ogee weir	
Crest Length (feet)	300	175	
Crest Elevation (ft, msl)	416	418	
Location	1.5 miles east of dam	Left abutment	
SDF Surcharge (feet)	14	12	
SDF Discharge (cfs)	59,700 (spillway) 13,200 (conduit)	28,500 (spillway 4,600 (conduit)	
SDF Peak Inflow (cfs)	135,000	68,000	
OUTLET WORKS			
Type and Number	3 square conduits (2 flood control, 1 forebay)	1 circular conduit	
Conduit Inside Dimensions	11 feet x 11 feet	8 feet diameter	
Conduit Lengths (feet)	Flood control 124, forebay 128	350	
Invert Elevation (feet, msl)	366	325	
Service Gates	6 @ 12 feet high x 6 feet wide (4 flood control, 2 forebay)	3 @ 6 feet high x 3.5 feet wide	
Emergency Gates	1 @ 12 feet high x 6 feet wide	None	
Downstream Channel Capacity (cfs)	7,000	1,500	
Maximum Discharge Capacity (spillway crest elevation)	14,000 cfs	2,900 cfs	
Stilling Basins			
Number	2***	1	
Size	32 feet wide x 67 feet long	30 feet maximum width x 50 feet length	

DIKE FEATURES

	H-2	H-3	P-1	P-2
Type	Compacted earth fill with rock slope protection			
Length (feet)	5,220	4,400	4,050	2,630
Top Elevation (ft, msl)	435	435	435	435
Maximum Height (feet)	66	67	50	30
Conduits	Dike P-1 only: Inlet elevation 384.6 feet msl Dimensions: Length 220, width 4 feet, height 5 feet			

CANALS

	Canal No. 1	Canal No. 2
Designation		
Bottom Width (feet)	120	160
Length (feet)	4,000	10,400 (from North Weir to South Weir)
Side Slopes	1 on 2.5 to 1 on 3	1 on 2.5

			Total Acres
LAND ACQUISITION			
Fee Taking Elevation (ft, msl)	410	400	7,910 Fee
Flowage Easement Elevation (ft, msl)	420	420	2,024 Easement
Downstream Flowage Easement (cfs)	7,000	1,500	
MAXIMUM POOL OF RECORD			
Date	April 1969	April 1969	
Elevation (ft, msl)	405.0	397.1	
Percent of Flood Control Storage	0	0	47
UNIT RUNOFF			Both Projects
One Inch Runoff (acre-feet)	-	-	23,760 (net)
OPERATING TIME			
Open/Close All Gates	15 minutes	20 minutes	
PROJECT COST (Through FY 1974)	-	-	$21,360,000
DATE OF COMPLETION	October 1962	December 1961	-
MAINTAINED BY	New England Division, Corps of Engineers		

* Net drainage area - does not include 44 square miles controlled by MacDowell Dam

** Net (flood control) above permanent pool

*** For flood control conduits; forebay conduits empties into forebay pool (w.s. elevation = 390 feet)

PLATE 3

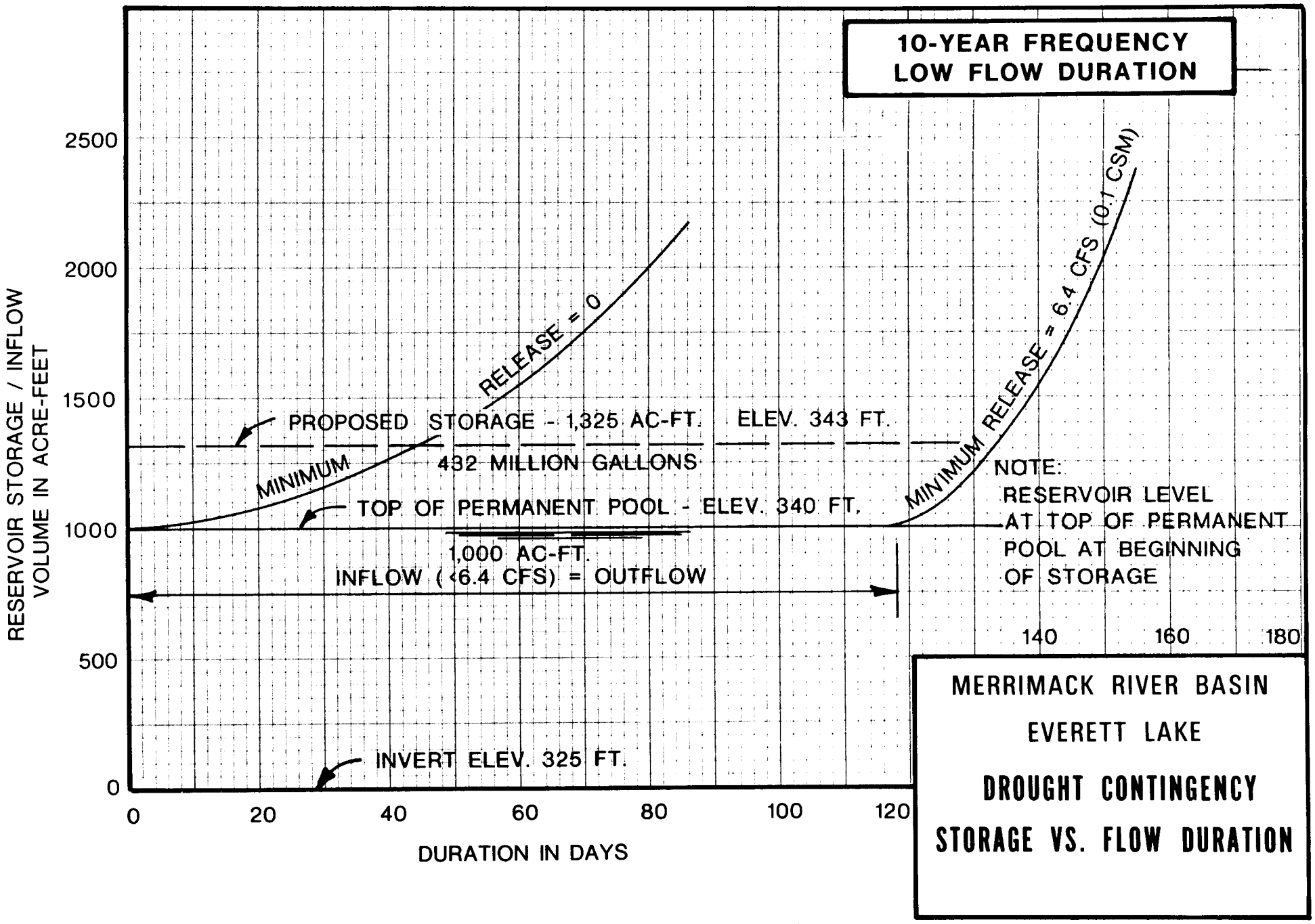
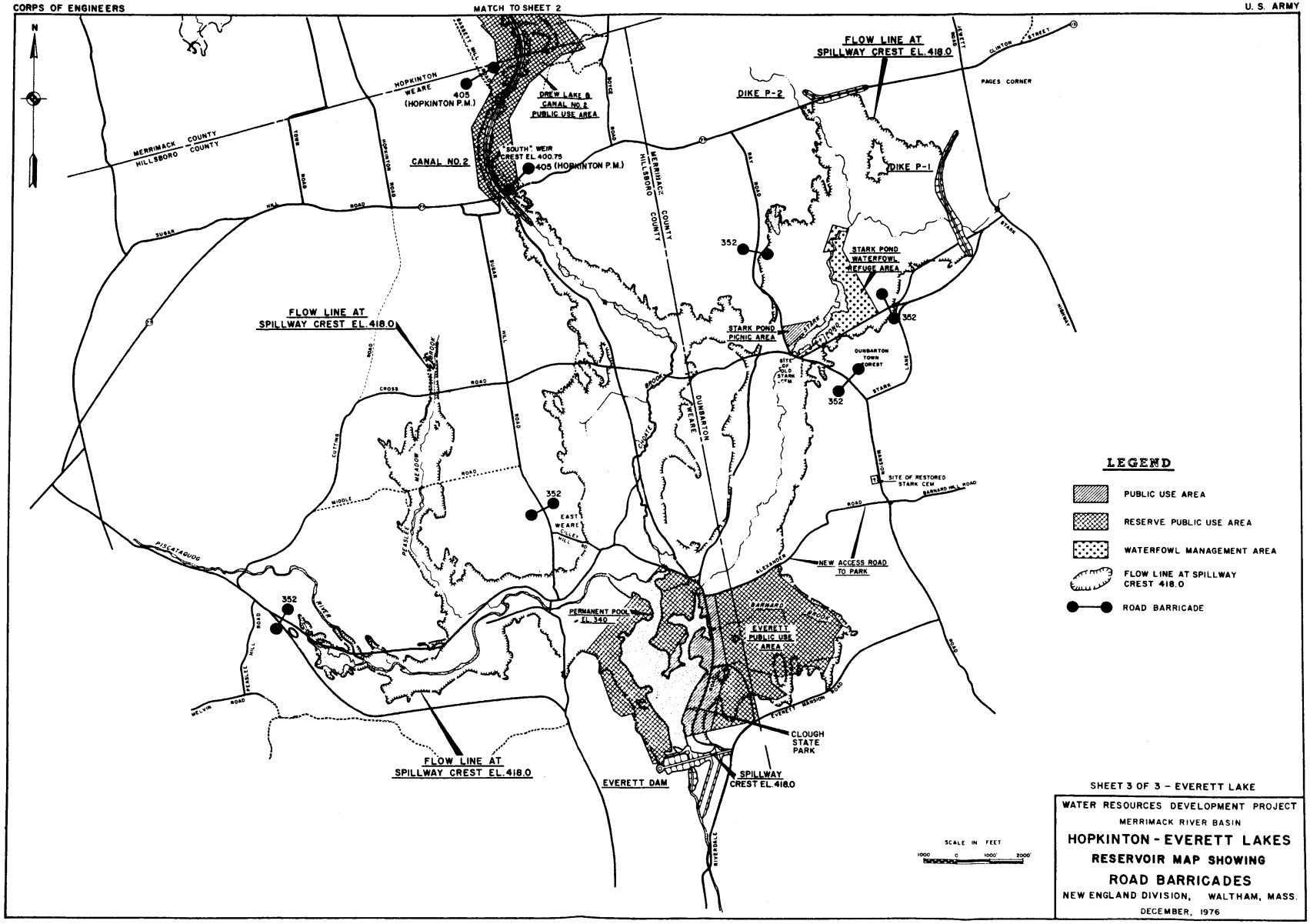

10-YEAR FREQUENCY
LOW FLOW DURATION
RESERVOIR STORAGE / INFLOW
VOLUME IN ACRE-FEET
2500
2000
1500
1000
500
0
RELEASE = 0
MINIMUM
PROPOSED STORAGE - 1,325 AC-FT. ELEV. 343 FT.
432 MILLION GALLONS
TOP OF PERMANENT POOL - ELEV. 340 FT.
1,000 AC-FT.
INFLOW (<6.4 CFS) = OUTFLOW
INVERT ELEV. 325 FT.
MINIMUM RELEASE = 6.4 CFS (0.1 CSM)
NOTE:
RESERVOIR LEVEL
AT TOP OF PERMANENT
POOL AT BEGINNING
OF STORAGE
0
20
40
60
80
100
120
140
160
180
DURATION IN DAYS
MERRIMACK RIVER BASIN
EVERETT LAKE
DROUGHT CONTINGENCY
STORAGE VS. FLOW DURATION

PLATE 4

CORPS OF ENGINEERS

MATCH TO SHEET 2

U. S. ARMY



SHEET 3 OF 3 – EVERETT LAKE

WATER RESOURCES DEVELOPMENT PROJECT

MERRIMACK RIVER BASIN

HOPKINTON - EVERETT LAKES

RESERVOIR MAP SHOWING ROAD BARRICADES

NEW ENGLAND DIVISION, WALTHAM, MASS.

DECEMBER, 1976

PLATE 5